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ABSTRACT

Computer uses in the classroom is the theme topic of this journal issue. Contents include: "Emo Welzl: 1995 Leibniz Laureate" (Hartmut Wewetzer); "Learning to Read with the Aid of a Computer: Research Project with Children Starting School" (Horst Meermann); "The Multimedia School: The Comenius Pilot Project" (Tom Sperlich); "A Very Useful Piece of Equipment: Education Expert Alfons Rissberger On the Use of Computers in the Classroom"; "Farewell to Passiveness: Multimedia Project With Disadvantaged Young Persons" (Franz Piesche-Blumtritt); "Learning Via Satellite: New Paths in Inplant Training" (Hans-Christian Rofsler); "Surrounded by a Sea of Universal Knowledge: New Media Establishing Themselves in Higher Education" (Hilde Malcomess); "The Greenhouse Effect: Everybody's Talking About CO2--But What About CFCs, Methane and Near-Earth Ozone?" (Mojib Latif); "Research for the Next Millennium: Genetic Engineering and Environmental Conservation in Agriculture" (Christopher Maas & Jeff Schell); and "The Fulbright Idea." There are also six "News in Brief" articles. (MAS)

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EDUCATION AND SCIENCE II/1995

COMPUTERS IN THE CLASSROOM

THE SCHOOL OF THE FUTURE

THE FUTURE OF THE SCHOOL

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EMO WELZL:
1995 LEIBNIZ LAUREATE

A DYNAMIC CAREER

Algorithmic geometry, probabilist algorithms? Most people would be embarrassed and at a loss on being confronted with these terms from computer science – even though the latter is dominating our everyday lives more and more. For Emo Welzl, they represent the focal point of his daily work. The 36-year-old computer-science professor at the Free University of Berlin has done great things in these fields and has now received his due reward: Welzl is the youngest of the 13 Leibniz laureates in 1995. This generously-endowed promotive prize, awarded by the German Society for Promotion of Research, has enabled Welzl to invest DM 1.5 million in his research work for the next five years. He may not spend the money for private purposes. But one thing is sure: Welzl will have fewer problems in the next few years – such as with the strapped financial situation of universities. He can now employ staff to assist him.

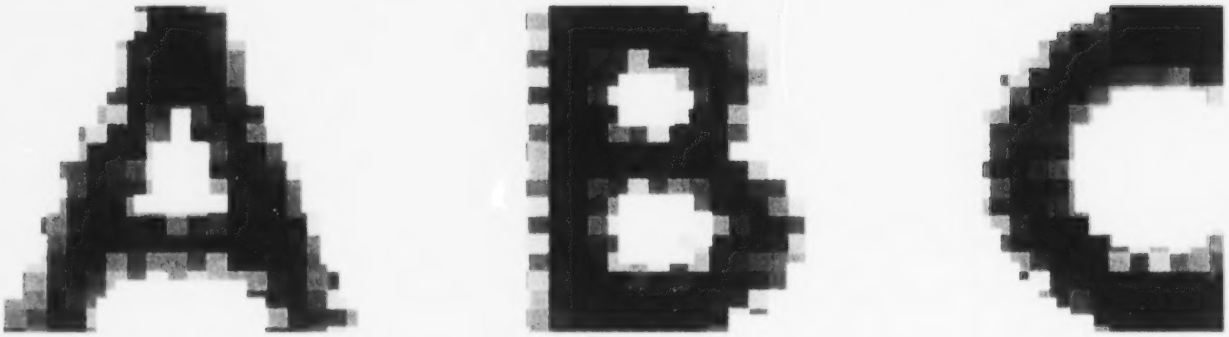
Welzl is an academic "whiz kid". Born in Linz on the Danube, he studied and gained his doctorate in Graz before being appointed, aged 29, to a professorship at the Free University of Berlin. Welzl, an amiable and modest person, recalls that all the students attending his first lecture were older than he was. Many thought he was a fellow-student. He claims to have been "misquoted" when the university magazine alleged he had stated that a mathematician's creative period was over by the age of 30. But he does not deny that the Free University's courage in appointing a young man professor is now paying off.

On being asked what makes a good scientist, he replies succinctly, after a moment's hesitation: "He must be able to break out of prescribed paths." Even so, Welzl attaches great importance to the fact that the prize not only honours an outstanding individual but also the work of his whole team. Welzl is what is known as a theorist, i.e. he does basic research. This, however, does not mean that this amateur cook and sportsman indulges in theories far removed from reality. On the contrary, he describes his workplace as somewhere where ideas are forged, where mental bases for new and more efficient switching circuits, robots and computer graphs are thought up. Medicine and space research are further fields which can profit from Welzl's research. One such project, for instance, is the question of what a computer must look like which makes orientation easier for a space satellite – no easy task in view of the thousands of stars.

Welzl's team at the Institute of Computer Science is also experimenting with the element of chance. Paradoxically it is to help make computer programmes simpler and quicker. In the meantime, Welzl has contacts with industry. "But one has to bother about these oneself. They don't come of their own accord," he says from personal experience. Welzl is also spokesman for the postgraduate course "Discreet Algorithmic Mathematics" in which he collaborates with the second Berlin laureate, Professor Martin Grötschel from the Technical University. Welzl, who has a four-year-old son, is electronically abstemious at home. He owns neither a computer nor a television. "If I had one, I'd only be sitting in front of it all the time."

Hartmut Wewetzer
(Berliner Tagesspiegel)

LEARNING TO READ WITH THE AID OF A COMPUTER



Can children of primary-school age (five to seven) learn to read more easily by using computers? This question is being tackled by a project entitled "Computer and Acquisition of the Written Language" at the Max Planck Institute of Psychological Research, Munich, under the leadership of Prof. Wolfgang Prinz, the managing director of the institute. The project was launched four years ago as a scheme by the German Society for Promotion of Research. Now, in collaboration with the Bavarian State Institute of School Pedagogics and Educational Research, Munich, ways are being examined of learning to read with the aid of a computer in class.

Reading confronts children with a special problem which adults are not in the slightest aware of any longer: the written structure has to be converted into a phonetic structure. There are specific rules for this which are different in every language and in some cases very difficult and complex. Prof. Prinz explains: "At first glance, these conversion rules seem very simple but are extremely complicated, such as in German, for instance. A written >a<, for example, does not always have the same phonetic value. On the contrary, it varies between a long and short sound. Furthermore, an >a< within a word can have a completely different sound (such as when followed by an >i<, such as in >Mai<, the German for May. This lack of clarity in the conversion rules represents a major obstacle for children who want to learn to read.

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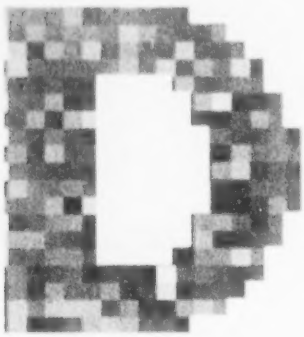
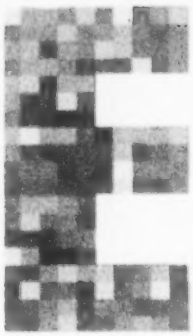
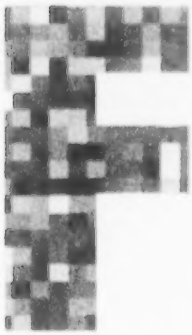
This is the point of departure for the project by the Munich-based Max Planck Institute. "In the reading process, we are trying to use the computer for a very specific function, i.e. to provide children simultaneously with the written and spoken language." A teacher can only do this fragmentally. He can do nothing more than point to a specific part of a text or line and then speak the sounds of the written words aloud for the children to hear. A computer, on the other hand, can offer the child the written and phonetic form of language simultaneously. To this end, the spoken language is "fed" into the computer.

For those starting to read, who must first learn the coupling of the written and acoustic word, it is of utmost importance that the individual sounds are pronounced precisely and in a clearly distinguishable manner. It is here that the computer resembles a tape-recorder –

Research project with children starting school







without having to wind back and forth, however. On the contrary, the child can fall back on every previously stored text segment. In this process, the child selects the written text itself and retrieves the spoken part. The child can touch specific parts of a word on the computer screen which then stand out. The computer pronounces the part of the word correctly (such as >Va< in >Vater<, i.e. father, then >ter< and finally the whole word).

The great advantage of this method of learning to read is that the computer has endless patience. In a class of 20 to 30 pupils, a teacher usually doesn't have time to devote his attention to one individual child which has problems, say, with a certain sound. The project developed by the Max Planck Institute has made learning material available which allows the teacher to provide a child with this intensive assistance without having to neglect the rest of the class: the advantage for children is that they can practise independently, i.e. effortlessly, without feeling themselves exposed to the immediate pressure of having to succeed – which would possibly be the case if the teacher were directly involved. The computer remains "cool", revealing no emotional reactions such as impatience or reproach.

Critics point out, however, that the use of computers impairs the teacher-pupil relationship and that this premature resort to such technology robs small children of part of their childhood. The experts from the Max Planck Institute regard this argumentation as ill-founded since computer programmes of this nature are not designed to replace the teacher's social function – which they can't do anyway- but to provide him with relief to be able to attend to other tasks. What is more, in handling a computer, children learn to read in a more playful manner – a process, moreover, in which they act independently.

Horst Meermann
(MPG-Spiegel)

THE MULTI-MEDIA SCHOOL

Bearing the name "Comenius", five Berlin schools and a database are to be interlinked via a high-performance data network in the 1995/96 school year. This internationally-unique pilot scheme was initiated by DeTeBerkom, a subsidiary of Telekom, which has already launched a wide variety of projects in order to try out their fibreglass networks in practical usage and to find "market-tailored application solutions" for them.

The technology may be exciting, but the content is even more exciting. For the period of one year, pupils from two *Gymnasien* (grammar/college-preparatory schools), a *Gesamtschule* (comprehensive school), a *Grundschule* (primary school) and a *Jugendkunstschule* (youth art school) are to learn in a new, funlike manner within the Comenius system. Teachers, children and parents will meet in a "virtual classroom" and work with multimedia data and programmes. Comenius is to throw light on "what parts of the Telekom structure can be utilized and what services are necessary," explains Christine Seidel, who is in charge of the DeTeBerkom project.

The Berlin *Landesbildstelle* (state photographic service) is to act as the database from which Comenius can retrieve printed, sound and pictorial documents, films, music and computer programmes. The teaching material comes from the FWU, the Institute for Film and Photo in Science and Teaching. The latter is located in Grünwald, near Munich, and is generally responsible for Comenius. The FWU is a *Länder* (states) institution – anyone who went to school in Germany is familiar with these three letters which appear in the credit titles of films (such as the propagation of sticklebacks) used for educational purposes in the classroom.

"Everybody's talking about multi-media and telecommunication – we are now forging ahead in a concrete fashion with these new, virtual communication rooms in schools and preparing children to cope with information technology," says Dieter Kamm, director of the FWU and Comenius project leader. He maintains that the new technology will exert greater pressure on schools to change but that certain impulses are necessary for changes in the education system. "There is still much anxiety and reserve among the teaching staff," says Klaus Kilian, principal of the Bettina von Arnim School, which is to be hooked up to Comenius.

"That's only natural," comments Dieter Kamm. "Unlike the Nintendo Kids, teachers have not grown up with interactive technology. The children simply know more about it. This makes teachers unsure and puts them on the defensive." Kamm regards his advanced plans as an evolution.

"We are not trying to put something over with Comenius. We take the curricula as the basis for everything we develop and create cross-linking from the subjects which form new substructures in the learning process. And I am certain that, once the children have grasped it, then things will really get going. Teachers, who have the courage to participate, will experience a different but very pleasant role. They will be more like coaches than "cyber-crammers".

THE COMENIUS PILOT PROJECT

If Comenius is to be a success it must function in a highly user-compatible manner. One of the project participants with an impressively-sounding name – the Ponton European Media Art Lab- is to ensure this. This "think tank", a group of artists, scientists and technicians located in Podbi Park, Hanover, has been working with the new media since 1986. Ponton became known through interactive network art, such as "Van Gogh TV-Piazza virtuale" on the occasion of Documenta 1992 or Ars Electronica 1994 which was transmitted throughout Europe by the 3Sat TV station.

Salvatore Vanasco von Ponton sees one decisive advantage in Comenius: "The participants are to get to know each other and everyone will be able to test and develop himself without a strictly prescribed framework." One part of the essential structure – the three-dimensional user surface leading to the virtual classroom – is currently being developed at Ponton.

According to the concepts so far, the artificial world of learning presents itself as a group of buildings through which users move with a click of a mouse. Work is progressing on the projects or teaching taking place on the premises of the conference building.

Pupils, teachers or parents present are entered in a list and portrayed graphically as spheres, pyramids or cubes. They are surrounded by an "aura" with which contact is established by touch. By means of a video conference the participants see and speak to one another.

The teaching material is retrieved from the media database at the *Landesbildstelle*. This is also a house within the world of learning. A further house, the communications building, acts as the post office where letters and project papers for other persons can be deposited in post boxes – everything in electronic form, of course. There are also rooms where groups can meet for discussions. Projects can also be pushed ahead with by several classes, at various schools and via modem and telephone from at home.

The *Condat DV-Beratung* (data processing consultancy), Berlin, one of the Comenius project partners, is responsible for installation, training and concomitant support. "Outwardly, everything is easy to operate, but a few new technologies are being tested in the background," says Christof Peltason from Condat. By this is meant, for example, the high-performance ATM communications protocol which is regarded worldwide as the future standard for multimedia data transmission but which requires tests such as this before it reaches technical maturity. The total costs of the Comenius project is in the region of DM 5 to 7 million, the bulk of which is being provided by DeTeBerkom.

Dieter Kamm views the Comenius project as a "nucleus" which later, in adapted form, will also "take root" in other *Bundesländer* (states). The *Kultusministerkonferenz* (Conference of the Ministers of Education and Cultural Affairs of the *Bundesländer*) has also now reached agreement on the assumption that "the screen will stand alongside the 'classical' book as a teaching medium". There is even the idea of making the new technology socially acceptable in this way: the information interlink between schools could be gradually developed into a widespread communications network in Germany (and internationally).

If the name of the project is anything to go by, one can hope for the best. Johann Amos Comenius, a pioneer of modern media education, realized as far back as the 17th century that "everything flows on its own – far removed from external compulsion".

Tom Sperlich
(Die Zeit)

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A VERY USEFUL PIECE OF EQUIPMENT

Educationalist Alfons Rissberger, one of the initiators of the memorandum entitled *"Learning more actively: multimedia for better education"*, is calling for more computers in schools. The memorandum warns against the danger of schools "missing out on the computer age". The signatories to the memorandum include representatives of education authorities, higher education institutions, hard and software firms as well as the chairman of the Federal Parents Council.

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Mr Rissberger, you maintain that schools are missing out on the computer age. Yet almost all pupils are offered the opportunity of learning how to operate a computer in school.

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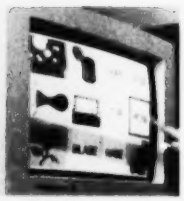
It is not just a case of mastering the keys. It concerns a new quality in the imparting of knowledge, completely new forms of teaching. Computers can portray complicated subject-matter more graphically. Take, for instance, having to explain the disintegration of a chemical compound or to provide a clear picture of what the interior of a volcano looks like. Special software makes more child-tailored, easier and more effective learning possible.



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How is this supposed to work?

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The computer can be equipped with the experiences and methods of the best educators, it adapts itself automatically to the learning speed and the capability of the child, the pupils can learn at home or in the classroom, when and where they like. With the new programmes all senses can be activated via print, picture, sound or film.

EDUCATION EXPERT ALFONS RISSBERGER ON THE USE OF COMPUTERS IN THE CLASSROOM

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But that means the children stare silently at the screen all day.

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They don't, have no fear. Practice shows that pupils talk to each other, help each other, are very active when they sit in front of the computer. Furthermore, we know from long-year project work that girls and boys enjoy learning much more with the computer.

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Is the teacher to be replaced by the computer?

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By no means. The machine will always remain an additional tool in the classroom – but an extremely useful one. The teacher will have to impart his knowledge to a much lesser degree or say what is right or wrong. On the contrary, his qualities as an educator and adviser for the children are required.

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Many teachers reject the computer.

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Only because they have no experience in using it. 2000 years ago, Plato was opposed to the introduction of writing in education. He was convinced that anyone taking notes could not listen in a concentrated manner. Some years ago teachers were opposed to pocket calculators even though they had long been in widespread use by pupils. Portable computers will complement and in some cases replace exercise and text books as a matter of course in the school satchels of tomorrow. The computer does not obstruct thinking: it promotes it. In actual fact, in the end, the teachers participating in pilot projects, no longer wanted to do without the computer.

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It has nevertheless not got beyond a few isolated experiments. In the USA, Canada and Japan they are in some cases part of the everyday scene in the classroom.

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We are now touching on the crucial point. Many education ministers, indeed, the majority of education policy experts, hardly know how to operate a computer themselves. For the future, this would be the same as the owner of a driving school not being able to drive. The responsible politicians must act now, they must equip pupils with computers and software – on a comprehensive basis. Otherwise we shall fall behind internationally. Many children have state-of-the art computers at home anyway.

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Schools often lack the funds to buy expensive computers.

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Here, the finance ministers must establish the priorities. The most important cornerstone in the economic and scientific fields is human capital. Our children must be well-prepared for the future. There are already higher education institutions in the USA, for example, which only admit students with an efficient electronic notebook. Moreover, it must be compatible with the university network.

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What do you want to do with children who feel overtaxed by all this technology? Not all girls and boys are *au fait* with computers?

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The difficulties are experienced mostly by parents. Children know exactly when it is too much for them. Even before entering primary school, for instance, my daughter Lisa either drew with crayons on paper, with chalk on the street, or designed a birthday invitation on father's computer – for the most part, however, she preferred to romp around outside.

(Der Spiegel)

FAREWELL TO PASSIVENESS

MULTIMEDIA PROJECT WITH DISADVANTAGED YOUNG PERSONS

Teaching has become more action-oriented, independent and individual in the choice of learning paths in recent years. A project by the Society of Information Technology and Education (GIP), Moers, shows that the computer is supporting this development effectively and able to provide useful service in the case of vocational qualifications for young slow learners. (1)

The fact that young persons make multimedia clips within the framework of their trade training and are consequently expected to acquire a vocationally-relevant qualification usually prompts surprised if not sceptical reactions, particularly when it becomes apparent that the target group in question is incapable of reaching the required vocational-training standards without assistance in the programme for disadvantaged persons. As multimedia technology is regarded as complicated territory, the idea has spread that multimedia programmes can only be produced and used by media-developers. Our project experiences show, however, that the manufacture of multimedia clips is also possible with young persons, provided methodology and technology are tailored to the target group in question.

Young persons, who constantly consume ready-made media in their free time, become authors and media producers in our multi-media projects. The process topics which they choose themselves and find interesting. "Fashion Show", "Travel Report", "Animation of a Picture Book", "Condoms", "Music Clips", "Self-Portrait" – as well as "How Does a Veneer Press Work?" and "Industrial Safety in a Wood Workshop". The wide range of topics shows that multi-media projects in initial vocational training, as we understand it, must not be restricted to purely vocation-related subjects. Topics from the young persons' working world are likewise suitable for the development of vocation-related qualifications and offer starting points for social-educational work which is part of the training programme for disadvantaged juveniles.

Multi-media projects begin with a selection of topics, a clear circumscription of subject and purposeful acquisition of information and picture material. The rapid accumulation of material must be kept within manageable limits since the young persons are supposed, as far as possible, to discover in them independent structures, hierarchies and correlations in order to be able to develop the initial concepts of possible pictorial messages and programme structures on this basis.

This is followed by a sifting of the material which, apart from the collection of information, serves, first and foremost, the discovery of the subject's content structures. This is the key element in multimedia production. Here, parallel to the acquisition process, an idea of what the multimedia clip should contain and show begins to take ever increasing concrete shape. Developing the content structure of a multimedia clip is linked with operating sequences in which the assembled material must first be registered, analyzed, classified, selected and subsequently modified, adapted to one's own ideas, re-arranged and put together. In so doing, the young persons open up bit by bit an extensive field of topics, become proficient and present selected subject-matter in a structure which they themselves have developed. In this context, multimedia PC and software assume the function of a catalyst since the programme authors are forced to structure their knowledge and what they wish to convey in a precise manner to portray this in a multimedia system. In so doing, they employ various forms of portrayal which range from travel report and reference work to music clip, or the animation of a scanned picture book, including script and sound-track written and spoken by the young persons themselves.

The potential of multimedia systems outlined here will only bear fruit, however, if the complexity of the technology and tasks involved in the difficult phases of the development process can be reduced in a flexible manner and adapted to the basic learning requirement of the trainees.

Programme development processes with extensive planning phases preceding production, as is normal practice in the professional sector, quickly showed

themselves to be unsuitable. Since ideas on programme creation depend on powers of imagination, the demands on linguistic expression, as well as imagination in terms of space and time, are as a rule too great, at least as far as young persons with learning difficulties are concerned. These requirements can be considerably reduced by means of perception-guided tasks. By means of this method, only a brief pause for reflection about a suitable start and further development follows the idea and wish to create a specific topic. The initial suggestions for the creation of the first sequence are taken up right away and realized technically. The concretization and realization of the initial idea, which, in the first instance, is nothing more than a rough idea, now takes place directly on the monitor in close cooperation with several digitalization stages. In this way, one screen page after the other is created, each of which can be developed along various lines which the young persons can derive associatively and spontaneously from the state of the operation in question.

The basic requirement for this process is technical equipment which reduces the gap between the development of an idea and its realization. We have provided the requirements in a multimedia studio which, by means of a user-friendly network, links the main working fields of the programme development:

– Sound PC: for the digitalization of music or language and the post-processing of sound sequences (recording, mixing, alienation)

– Graphics PC: for the digitalization of pictures and graphics with a scanner and subsequent processing (scanning, retouching, mounting ...)

– Video PC: for the digitalization of video sequences and pictures (recording, cutting, selection)

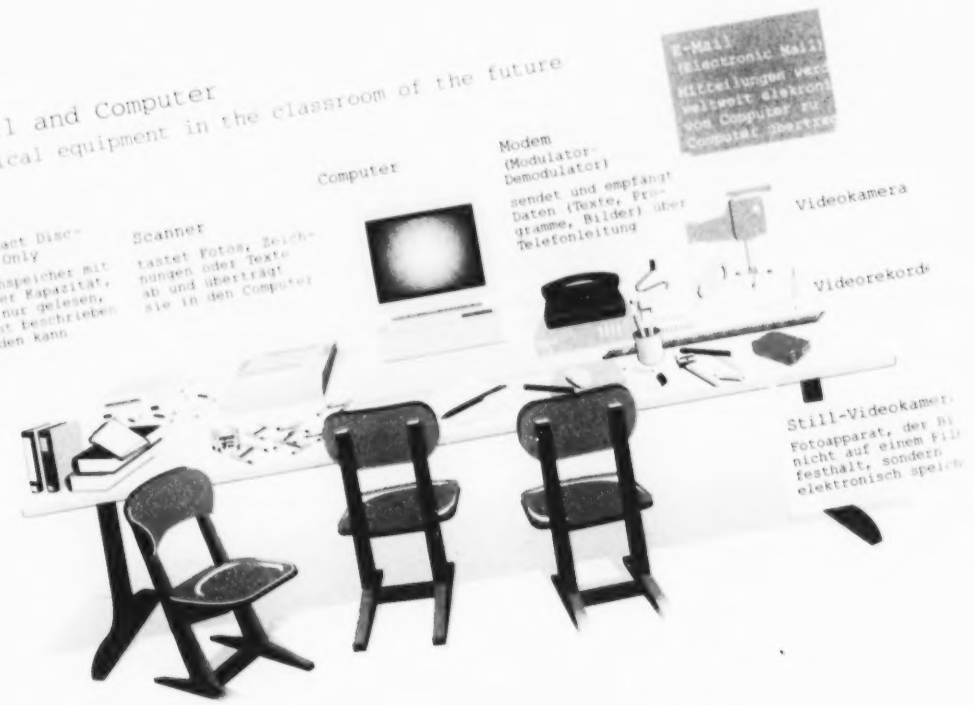
– Performance PC: for the bringing together and synchronization of the various media in a multimedia clip.

Suitable material is selected and digitalized to realise an esthetic idea. Since the initial digitalized material can appear immediately on a screen via the network, an overall visual impression of the initial idea rapidly takes shape. The young persons now have the elements and objects right "in front of their eyes" and are able – at least with the aid of a mouse – to take direct action, such as changing the size and position, for example.

Bearing the learning aims in mind, what is really of interest is not so much the end product but the production process. In this context, the software created is first and foremost a catalyst for the acquisition of a qualification from the professional angle. What is more, the technical possibility of experimenting as much as one likes, the furnishing of pictures with commentaries, for instance, removes the fear of making mistakes and encourages correction. Particularly in the case of young persons with speech difficulties or inhibitions, technology helps them to express themselves, to gain confidence and reflection of expression. Apart from basic communicative orientation inherent in work designed to produce media, informative and illustrative material for others, the production process itself is a challenge for the development of cooperation and work-sharing. Our experiences show that professional multi-media technology, embedded in a corresponding methodology, is basically suited to our target groups and supports the development of occupation-overlapping qualifications, particularly in the case of young persons with learning problems.

Franz Piesche-Blumtritt

1) This project is being promoted by the European Union's "horizon" programme



LEARNING

NEW PATHS IN INPLANT TRAINING

"How do I adjust the bearing clearance?" asks an automobile master craftsman from Hamburg. The instructor in the Mercedes television studio near Stuttgart interrupts his lecture. He goes to a model of the latest engine-transmission unit. The camera follows him. "I measure at this point," he says and points to a spot on the engine block. More than 100 of the Hamburg mechanic's colleagues all over Germany follow this live question-and-answer game between Stuttgart and Hamburg. Via satellite they can see and hear both the instructor and the person asking questions on their screens. If there is something they do not understand, they can fade into the training programme like the master craftsman from Hamburg. This new learning system is called *Akubis*.

Whether it is Mercedes-Benz or Telekom, firms must often familiarize a large number of their workforce with new developments and provide them with additional knowledge in a short time. Very often, many employees are spread over the whole country in branches and subsidiary firms. To cope with this task, enterprises have been falling back lately on multimedia and interactive computer technology. Seminars are still the most common form of further training. But they are time-consuming and expensive: much time is lost between the emergence of a problem via further training to its solution. Staff are absent from their place of work, travel expenses have to be paid.

Mercedes employees, who participate in further training courses within the framework of the Akubis system, no longer need to take long trips at the firm's expense. There are currently 15 stations in the whole of Germany which are equipped to undertake training courses of this nature. Akubis has been in operation since 1993, says Michael Broßmann, who is responsible for EDP-supported training at Mercedes. When the new C-class was introduced in the spring of 1993, Mercedes, by means of this method, acquainted 4,000 persons – mainly managerial staff in subsidiary firms and workshops – with the new cars within a space of 20 days. There was a total of 100 transmission days in 1994.

SATELLITE VIA

The aim, however, is to increase the number of stations linked with Akubis to 40 or 50 so that no member of staff in Germany needs to travel longer than half an hour to the nearest station. In this way, with 900 transmission hours, it is planned to train up to 20,000 employees a year by 1996. A normal day's training lasts four to five hours. After a theoretical introduction, the trainer in the studio sets the participants a problem which they have to solve locally. The results are subsequently discussed jointly. At the present time, Akubis only accounts for 15% of inplant further training. The traditional seminars provide the bulk of further-training events. Even so, new interactive audio-visual systems are being developed.

Like most CBT training programmes, the Funline lessons have one great disadvantage. They are a one-way street, i.e. the apprentice has no-one he can ask questions. By means of Teleteaching, Telekom is trying to remedy this situation. Recently, 800 employees participated simultaneously in further training via satellite which was transmitted from a Telekom studio in Freiburg. The participants were able to contact the instructors direct via Telekom and fax. Video-conference circuits and picture telephone also allow experts to be included.

Telekom would no longer be able to cope with the growing volume of further training by conventional instruction methods. "Telekom has to reckon with at least 700,000 learning days annually, which do not include induction and further training at the workplace," says Frerich Görts, one of the directors. The enterprise is following new multimedia paths with "Funline" and "Teleteaching". Funline consists of computer-based instruction (CBT) which has been devised for apprentices who can choose from the 120 learning lessons, ranging from "The basics of digital technology" to "Communication-electronics engineer and environmental conservation". The lessons appear on the PC in one of Telekom's training centres via floppy disk or data circuit. Any number of apprentices can retrieve an instructional unit at any time. They decide their own learning speed and can repeat the various steps as often as they wish. Furthermore, information on new products or regulations can be quickly incorporated in the lessons.

Akubis, Teleteaching and Funline are training methods which Mercedes and Telekom only use internally. "Hypertrain", an integrated training system, which has been developed by Messrs *IKL Kommunikationstraining* and two other firms, is designed for all sorts of large companies. Instead of a transmission studio and satellite, the operators of the new system only use an adequate number of inter-linked computers. Hypertrain's distinctive feature: "The PC in the office is the learning and workplace simultaneously," explains project leader Bernhard Rieke. Hypertrain combines the advantages of a seminar with those of the computer-aided systems. The seminar instructor is integrated as a tutor who can be directly addressed. He is reachable for every hooked-up employee via telephone or computer line. Learning at the workplace instead of at a seminar, says Rieke, saves time and money. What is more, Hypertrain is capable of learning. If a tutor sees that several employees are experiencing the same difficulty, he can insert a learning unit or commission one. Staff can retrieve at any time the exact information they need for their work from the constantly updated database.

Hans-Christian Rößler
(Frankfurter Allgemeine Zeitung)

SURROUNDED BY A SEA OF UNIVERSAL KNOWLEDGE

NEW MEDIA ESTABLISHING THEMSELVES IN HIGHER EDUCATION

The lecturer sits in front of a computer and draws on a pad with an electronic stylus. At the same time 500 students in the lecture room watch as red, green and blue curves grow on the gigantic screen. The blackboard has had its day: the multimedia lecture with a wide screen is now "in". If the hopes of the project team, which is developing a multimedia teaching and learning unit for the lecture on "Performance /Cost Accounting", are confirmed, the new generation of students should learn more quickly and soundly than their predecessors – thanks to multimedia presentation software.

When describing this development Norbert Bolz, professor of communications theory at the University of Essen, says: "In the near future, the student at his computer will steer through endless masses of data like the pilot at his flight simulator." This is already the case in many places in the USA.

When California State University dedicates its new campus in autumn, there will no longer be a library building. Instead of thumbing through printed books, students will read digitalized literature on a screen and copy important texts or articles on a floppy disk. The first virtual university has existed since September last year in the Internet computer network. It uses a computer in California; the lecturers and students live on three different continents. Seminars take place, tests are held and papers discussed via computer and the Internet. Telephone costs are never more than to the nearest Internet nodal point, such as the nearest university, for example.

The computer revolution in German higher education, however, is dragging its feet. In 1994, the *Länder* (states) invested in EDP equipment costing between DM 800 millions to 1 billion. Most of this impressive sum benefited technical faculties, though. In the same year, private expenditure by students and lecturers was almost five times this sum.

Although nearly half the first-year students and nearly all graduates have a PC, most of them use it as a convenient typewriter. Yet a PC fitted with a telephone connection and a modem (this changes the computer data into telephone signals) can be converted into a high-tech workplace.

One dials into the computer centre at the university and gains access to the worldwide data network Internet and unlimited opportunities of communication between academics from all countries. Not all universities, however, offer their students this access. The computer capacity is often inadequate. And in those places where the opportunity exists, it is too little used. At the University of Cologne, with a student population of 60,000, just under 2,000 have access, i.e. have applied for the so-called "account" – in other words, every thirtieth. At the well-equipped private University of Witten/Herdecke, on the other hand, every second student regularly dials into the Internet – from the campus or from home. At many universities in the USA, all students are given a code number when registering and thus access to the Internet.

Since new networks were installed following unification, some of the universities in the eastern *Bundesländer* (constituent states) have very good EDP equipment. In the University of Jena, for instance, there is one workstation per five students: 2,000 networked computers for 10,000 students. In addition, they can dial-in from home but have to pay the telephone fees themselves, of course. The 40,000 students at the University of Bonn have to make do with 500 computer work places – one PC per 80 students.

At the end of last year, the Technical University of Chemnitz-Zwickau began to connect the student halls of residence with the university computer centre. The Federal Government, the Free State of Saxony, sponsors and students themselves are financing the project. Students can now use the huge Internet databases from their room and undertake worldwide literature research. They are having to make their way to the university less and less.

"Lecture papers, assignments or practical guidance can now be made quickly accesssible to all. The solutions to problems and questions can be dealt with by teaching staff or fellow-students by E-mail," explains Frank Schöniger, press spokesman for the Chemnitz student network working group.

Among others, the University of Münster, with assistance from the Bertelsmann Foundation, is exploring the possibilities offered by the multimedia of a more effective organization of teaching and enhanced learning success at universities. From the summer semester onwards, there will be multimedia lectures using videos and complex animations at the Institute for Economic Computer Science, supplemented by an electronic script which the students can work through on their own PC at home or on one of the Institute's 100 computers.

A researcher and her colleague are going a step farther at the University of Karlsruhe. They want to replace – not just supplement – the lecture "Creativity Techniques" at the Institute for Applied Business Management with multimedia software. In a dialogue with the computer (interaction), they solve problems and carry out simulations.

The production of software of this type is still extremely expensive and personnel-intensive. Even so, learning programmes of a more modest nature (CBT/computer based training) which students work on in front of the screen, are only used supplementary to traditional instructional methods.

Astonishingly enough, this also applies to open universities. "Our problem is the lack of equipment for the students and the high telephone costs incurred," says Dietrich Malecki, research assistant in the distance studies working group at the Faculty of Mechanical Engineering, Technical University of Dresden. There, as at the Open University of Hagen, correspondence courses still form the basis studies. Learning software is only used as a supplementary measure.

Professor Hans-Werner Six, incumbent of the chair for computer science at the Open University of Hagen is familiar with the problems surrounding the use of multimedia "The production of multimedia teaching and learning programmes is far too expensive," he comments. "Short-term, multimedia is more important as a means of communication for universities." Even so, the university has learnt that its 56,000 students reach more readily for the phone than go to the letterbox. They want direct feedback and to hear the voice of the lecturer. Conference circuits and discussion forums, in which the participants pin their contributions on a sort of common notice board which can be read and copied by all taking part, also come to grief because of the high telephone costs.

A worldwide communication and information network like the Internet provides access to such an enormous fund of knowledge that the basis of teaching must also be on a broader footing. Literature, such as old Latin and Greek writings, which had to be assembled from many different universities formerly, is now available on CD-Rom. Huge databases for medical and legal experts permit immediate access to the very latest findings and decisions.

Not only the limits of indigenous institute libraries are being exceeded. The opportunity of discussing questions with American or Japanese academics free students from their ties to one professor. Many different thought processes and points of view encounter each other in about 3,200 current discussion forums on the Internet. Students can discuss questions with experts and then present their lecturer with the point of departure the next day. In this way, Kugemann feels, healthy competition is created among teachers.

Future students and academics will be required to come to terms with the wealth of data. Intelligence is then the quality with which to exploit this wealth of information. Universities are not preparing themselves adequately for this key technology in coping with knowledge.

In the long run, the character of universities will change: academic communities – from students to Nobel laureates – could emerge on the basis of common specialized interests – without a hierarchy.

Hilde Malcomess'
(Rheinischer Merkur)

THE GREENHOUSE EFFECT

Man's actions discharge a large number of trace gases into the earth's atmosphere which affect the climate. Some of these gases, the greenhouse gases, partially prevent the radiation of the earth's heat which is resulting in a global increase in the earth's temperature and near-surface air layers. This can lead to global changes of climate with grave results, such as a rise in sea level. Currently, carbon dioxide (CO_2) accounts for 50% of this "anthropogenic greenhouse effect". The remainder is attributed mainly to four further greenhouse gases: chlorofluor carbons (CFCs) account for 18%, methane (CH_4) for 13%, near-earth ozone (O_3) 7% and laughing gas (N_2O) 5%. Measures to counter the greenhouse effect must consequently not only concern themselves with CO_2, but also with the other greenhouse gases .

EVERYBODY'S TALKING ABOUT CO_2 – BUT WHAT ABOUT CFCs, METHANE AND NEAR-EARTH OZONE?

The chief "sources" and "origins" of the greenhouse gases can be named with adequate accuracy:

The CFCs are purely synthetic substances and consequently have no natural sources. They were discovered in the 1930s and enjoyed a veritable triumphal march through industry and private households. They are used, for instance, to expand plastics, as cleansing agents and solvents, and as refrigerants in cooling plants. Annual CFC emission is put at 1 million tons worldwide. CFCs affect the climate in two ways. They not only make a substantial contribution to the greenhouse effect (they have the greatest greenhouse effect pro molecule) but are also the main cause of ozone destruction in the upper atmosphere. CFCs are very stable compounds and are practically only destroyed by "photo dissociation" at an altitude of more than 10 kilometres in the stratosphere. This explains their very long presence of up to 100 years, in some cases, in the atmosphere. Thanks to international agreements, the emission of CFCs is receding and the increase curve levelling off in the atmosphere. The 1986 Montreal Agreement was the first of its kind in which trace gases affecting the climate were regulated in the production process. The agreement has been tightened yet further since that time. Thus there is now hope that the CFC content of the air will stop increasing and gradually diminish long-term.

Methane remains a comparatively short time, i.e. about 10 years, in the atmosphere. The emission caused by human beings amounts to some 370 million tons a year. The chief anthropogenic sources of methane are: rice paddies (about 60 million tons), animal husbandry (85 million), incineration of biomasses (40 million), rubbish dumps (40 million), losses in the production and transport of natural gas (40 million) and coal mining (30 million).

The methane sources named clearly show that the emission of methane is closely coupled with food. In view of anticipated demographic developments, it will be consequently difficult to reduce the emission level in the case of rice cultivation or animal husbandry. The greatest success can probably be achieved by reducing the losses in the production and transport of natural gas. These occur mostly in the CIS for which systematic help by the western industrial nations is desirable. In addition, the emission from rubbish dumps must be considerably reduced.

A distinction must be made between the near-earth ozone and the stratospheric ozone at an altitude exceeding some 10 kilometres. Whereas the latter is of natural origin, the near-earth ozone stems, first and foremost, from anthropogenio sources and contributes significantly to the greenhouse effect.

What is more, it is extremely damaging to human health and exerts a negative influence on eco-systems, such as forests. Near-earth ozone has a relatively short length of stay of no more than a few months. It occurs principally in conurbations with a high level of air pollution. As a consequence, there is a marked difference between the northern and southern hemisphere. The preliminary substances for its formation are chiefly nitrogen compounds and hydrocarbons which emanate in particular from industry and road traffic.

On account of its enormous variability, time and spacewise, it is very difficult to make quantitative statements on the formation of near-earth ozone. Because of its very short lifetime, measures to reduce certain preliminary substances would virtually have an immediate impact – which would also weaken the greenhouse effect. Measures such as a marked and lasting reduction of road traffic, for instance, would consequently not only improve the quality of air; it would also have a bearing on climate protection.

Like CFC, laughing gas is highly stable (it has a lifetime of about 150 years) and is reduced almost exclusively in the stratosphere. Laughing gas originates mainly in the incineration of biomass and fossil fuels, as well as in the use of artificial fertilizers. A reduction in CO_2 would also have an effect on the emission of laughing gas as would a decrease of fire-clearance in tropical rain forests. It is also worth considering whether at least the industrial nations could not do without even more artificial fertilizers than at present.

Mojib Latif
(The author is a researcher at the Max Planck Institute of Meteorology, Hamburg)

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RESEARCH FOR THE NEXT MILLENIUM

GENETIC ENGINEERING AND ENVIRONMENTAL CONSERVATION IN AGRICULTURE

Genetic engineering has to contend with considerable problems of acceptance in Germany. The risk factor involved in this advanced technology has been much emphasized in public. The Genetic Engineering Act of 1990 has made due allowance for this justified concern and lays down that the results achieved by genetic engineering must, in their entirety, be of use to society and the environment – but in no way harmful. The following article shows what is possible in agriculture.

In the history of mankind, systematic selection and adaption processes have produced some 20 cultivated plants which are of outstanding world economic importance as a source of food, the main ones being wheat, maize, rice and potatoes. A marked increase in the yield and quality of cultivated plants began about 150 years ago and assured enough food for the rapidly growing population of the world. Progress in recent decades in increased yield through cultivation, fertilizers, plant protection, improved cultivation methods and expansion of crop acreage enabled agricultural production which has so far kept abreast of demographic developments. This, however, will be doubtful in future since we are now bumping against the limits of agricultural capacity - ecologically and areawise.

Since about the mid-1980s, plant cultivation research has been using biotechnological (genetic-technological) methods in increasing measure. Improvement of the substance-content of useful plants such as oils, starch, as well as enhancing resistance to plant diseases are the principal objectives. Despite intensive chemical plant protection by means of agrochemicals (pesticides), which, however, make a considerable contribution to agriculture's ecological problems, some 25% of crops are still lost worldwide because of plant diseases and pests.

This loss of yield in developing countries, in the very area where there is an increased demand for food, is somewhere around 50% or more. It is here, in particular, that there is an enormous potential in future for the breeding of new disease-resistant plants by a combination of classical cultivation and genetic technology.

In 1983, it proved possible to produce the first plants mutated by genetic engineering – known as "transgene" plants – in the laboratory. The technique of genetic transfer has been refined to such a degree nowadays that most cultivated plants, such as wheat, barley, maize, rice and potatoes can be "biotechnologically" mutated. To this end, genes from plant, animal, bacterium or virus can be systematically isolated and subsequently, by means of genetic engineering, be transferred across the boundaries of species. Even though genetic technology and its possibilities are still in their infancy, noteworthy progress has already been achieved.

Insect-resistant cultivated plants

Apart from large quantities of insecticides, such as DDT in the 1970s, the biological bacterium *Bacillus thuringensis* (B.t.) has been used for over 30 years and sprayed over large areas at great expense. In the meantime, more than 300 different types of B.t. are now known which produce certain proteins which kill specific insects. These genes can be isolated and transferred to plants. As expected, genetically-engineered plants of this nature (tobacco, tomatoes, cotton, potatoes and maize) revealed greater resistance to the European corn borer and the Colorado beetle. In this context, more recent findings suggest that a combination of various B.t. toxin genes in a plant can further enhance resistance to insect damage.

Fungus-resistant cultivated plants

In order to check the considerable losses caused by fungi, large amounts of fungicide are required in agriculture at the present time which, however, cause ecologically dubious residues. Natural defence mechanisms in plants make a reduction of pesticides possible, which, however, often come too late and not vigorously enough. Scientists recently succeeded in isolating antifungus proteins and, by means of genetic transfer,

producing them in greater quantities in tobacco plants. These proteins (chitinase, gluconase and RIP, among others', specifically attack fungi. It proved possible for the first time to produce evidence of the resistance in transgenetic tobacco plants to fungus attacks.

Even in the case of the first plants, a reduced amount of fungicides suffices to control fungus attacks. In addition, it has been recently confirmed that a genetic combination of various anti-fungus proteins improves the resistance to fungus attacks in greater measure than individual genes. This is not surprising when one bears in mind that natural defence reactions in plants consist of a highly complicated interplay of a large number of these antifungus proteins.

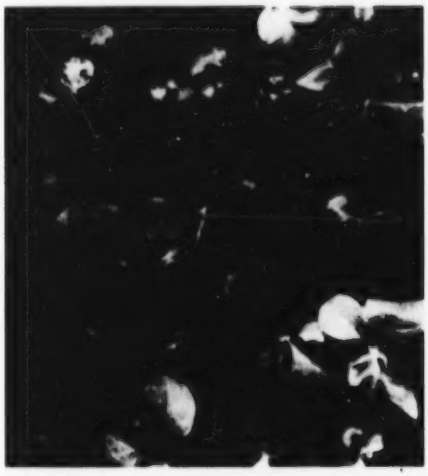
Herbicide-resistant cultivated plants

The competition between useful agricultural plants and weeds in respect of water, light and nutrients causes considerable yield losses. Herbicides, which the natural powers of resistance in cultivated plants stand up to, are used to destroy weeds. It has emerged, however, that the use of certain herbicides is no longer ecologically acceptable because of residue problems (e.g. the use *atrazin*, for instance, has been prohibited since March 1991). The dilemma is that a general abandonment of herbicides in present-day intensive farming is inconceivable. It is imperative to move towards the use of "ecologically compatible herbicides", i.e. those which are biologically better and more rapidly degradable. There are already herbicides available which come close to meeting this requirement.

Since they are highly active, only small amounts are required. Unfortunately, however, they are members of the total herbicides, i.e. they also attack cultivated plants. Neverthless by transferring resistant genes, it proved possible to make such cultivated plants as maize, rape, soya beans, wheat and potatoes resistant to these total herbicides. Future field experiments with genetically mutated plants will show whether plant protection with small quantities of these total weedkillers is as effective as the large amounts of various herbicide combinations used so far. The first results suggest this which would represent a purposeful contribution to the reduction of agrochemicals.

Rhizoctonia solani
Infection experiment

Infected, CHI/RIP



Infected, CHI/RIP

Infected, CHI/RIP

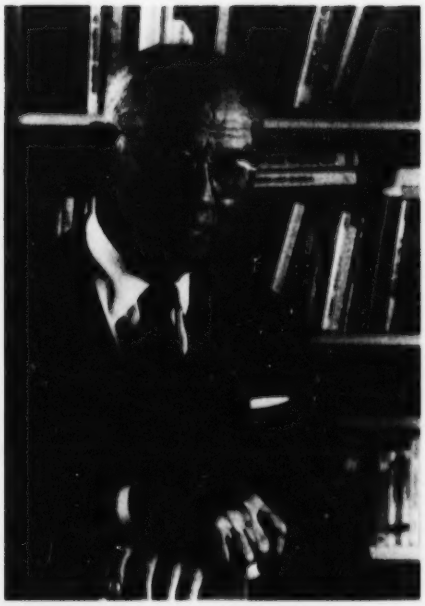
The risk potential and free cropping of genetically-mutated plants

The new combination and mixing of genes is a process which has been going on in the genesis of new species of plants for thousands of years but has always remained limited through the crossbreeding properties of plants amongst themselves.

Genetic engineering, however, enables the transfer of individual genes across the species barriers. Here, though, in principle, as is the case with every other technology, the danger of abuse exists. It all depends on what we do with it. Objections, such as, for example, that biotechnologically-mutated plants can exert influence on the eco-system and survival chances, and the transfer of these genes to soil organisms or wild plants, must be respected and answered. The resultant wish for caution, controls and security represents, in the final analysis, the basis of the Federal Republic of Germany's Genetic Engineering Act. The monitoring of use and the hitherto purely hypothetical risk potential of genetically-engineered plants can, in the final analysis, only take place in the controlled cultivation in safeguarded field areas. This field cultivation of genetically-engineered plants was carried out for the first time in 1986. Thereafter, by the end of 1992, within the 15 OECD member states, a further 863 field experiments of genetically-engineered plants were conducted in 1184 different locations with about 30 different cultivated plants.

According to R. Fraley (Monsanto), in the USA alone, a further 547 field experiments were carried out. An evaluation of these almost 1,720 field experiments showed that there have so far been no unexpected changes in the behaviour and spread of transgenetic plants. Thus the understandable worries seem now to be unfounded.

Christoph Maas and Jeff Schell
(Max Planck Institute of Cultivation Research)



THE FULBRIGHT IDEA

The American senator William Fulbright, who helped to shape American policy and was a staunch supporter of international organizations such as the United Nations, the World Bank and the International Monetary Fund, died in Washington on 9 February 1995. One of his greatest successes is the academic exchange programme named after him.

William Fulbright was born on 9 April 1905 and grew up in the rural northwest of the State of Arkansas. His education and college training were stamped by the tradional values of the American middle-class. A Rhodes scholarship enabled him to study at Oxford University in 1925. "The essence of intercultural training," said Fulbright, after his four-year study trip, "is to acquire the ability to see the world as others see it and to take into account the fact that others maybe see something which we don't see, or that they see it more precisely."

Because of the impression made on him by World War II and the dropping of the atom bomb on Hiroshima, his ideas began to take concrete shape. His conviction that academic exchange was personality-forming and can be defined as an instrument of foreign policy aimed at understanding, prompted Fulbright even as early as 1946 to attach special importance to German-American exchange. Thus the Fulbright Programme helped German university teachers and students to be re-integrated into the international academic community at an early date.

The basic objectives of the Fulbright Exchange were and still are the "promotion of mutual understanding", "the advancement of knowledge and education" and the creation of a programme by equal partner countries – one of which is always the USA.

Today over 130 countries are participating in the worldwide Fulbright Programme which has so far provided more than 200,000 students, teachers and academics with the opportunity to further train in the USA.

Ever since Federal Chancellor Konrad Adenauer and High Commissioner John J. McCloy signed the German-American Fulbright Agreement in 1952, the German-American programme has played a leading role in the worldwide Fulbright Programme.

The first participants in the German-American Fulbright Programme were students and professors – still the largest group today of the scholarship holders dispatched annually by both sides.

Teachers and teaching assistants have been taking part in the exchange since the 1960s and *Fachhochschulen* (colleges for higher professional training) have been included in the Fulbright Programme since 1972, thus enabling them to participate in the exchange with the USA, too. There are also exchange programmes for German and American experts in higher education administration, for members of the *Akademische Auslandsämter* (offices at universities especially concerned with foreign student affairs) and for German and American regional studies experts who further train – professionally and academically – within the framework of summer seminars in the respective country.

The planned Fulbright professorship for German Studies, which is to be set up at an American university on the occasion of the 50th anniversary of the Fulbright Programme in 1996, is taking into account the increased promotion of studies on Germany in the USA. Thus this programme is being integrated into the extensive range of "German Studies" courses in the USA. Conversely, a guest professorship of American Studies is planned at a German university.

Whether Fulbright scholars take part in the programme for academics and students or in the promotion programme for educational experts – all are distinguished by "academic excellence". All of them also share a common interest in reciprocal exchange, transcending the academic or professional sector. Consequently, applicants for a Fulbright scholarship are not only questioned about their academic or professional ideas, but also what they are able and want to contribute personally to the transatlantic exchange as unofficial ambassadors.

A PICTURE THAT MADE HISTORY

The hand shown here belongs to anatomist privy councillor Albert von Koelliker and was taken by Wilhelm Conrad Röntgen shortly after the latter discovered the rays which are named after him (in German) on 8 November 1895 (but known as x-rays in English). At that time he was head of the University of Würzburg's Physics Institute. The ring on the finger can be seen clearly. This photo is part of an exhibition entitled "100 Years of X-Rays" which can be seen in the Martin von Wagner Museum at the Würzburg *Residenz* until 19 November 1995. Among the precious exhibits is the equipment used by Röntgen. The exhibition provides information on Röntgen's life and work as well as on the physical properties of x-rays. The wide range of exhibits, collected from all over Europe, includes the certificate confirming the award of the Nobel Prize to the researcher (1901), an old dosimeter and modern computer tomograms. The exhibition also explains that by means of "x-rays", as Röntgen called them ("x"meaning unknown), structures of matter can be determined and finds from the Iron Age examined. Satellite pictures reveal that many stars emit x-rays. The exhibition is part of the "Year of Science" at the University of Würzburg.

DEATH OF NOBEL LAUREATE GEORGES KÖHLER

Georges Köhler, the German immunological researcher, 1984 Nobel Prize winner for medicine and director of the Max Planck Institute of Immune Biology in Freiburg, has died. He was only 48 years old. Together with Argentinian Cesar Milstein, Georges Köhler was the first person to succeed in mass-producing monoclonal antibodies, i.e. the production of endogenous antitoxins. Köhler and Milstein used special cells for this purpose.

Antibodies are formed by the defence system to identify and neutralize invading pathogens or cancer cells. Each of these protein molecules attaches itself to only very specific parts of the pathogen which means that there are many different types of antibodies. On the basis of the principle developed by Köhler, any special (monoclonal) antibody required can be systematically produced today. By means of specially marked monoclonal antibodies, it is possible to track down tumour foci in the body, thus improving the healing chances.

PLENTY OF FRUIT AND VEGETABLES, MEAT IN MODERATION AND VERY LITTLE FAT

Correct nutrition from childhood onwards can considerably reduce the subsequent risk of suffering from typical civilization illnesses such as cardiac insufficiency, obesity, high blood pressure, bone atrophy and certain types of cancer. Representatives of the German Society of Food Medicine (DGEM) drew attention to this correlation at their annual conference in Darmstadt. Food-related illnesses and allergies cost the German health-care system DM 70 to 80 billion a year.

"By observing three simple basic rules from earliest childhood on, the likelihood of an illness can be prevented," said medical expert Hansjosef Böhles, the DGEM's president-elect. Plenty of fruit and vegetables, meat in moderation and very little fat. Preventive nutrition promises greater success, the sooner it is commenced. In this context, the prenatal period is of great importance. Incorrect or malnutrition during pregnancy considerably encourages metabolic disorders at a later date.

Böhles, however, also warned against one-sidedness. Rickets, the deficiency disease long thought conquered, is now returning as the result of rigorous nutritional principles. The former "poor people's" disease is now mainly affecting children from "intellectual families" in which the eating of any form of animal product is rejected.

The Frankfurt pediatrician also called for greater attention to be paid to sport in childhood and youth. The importance of adequate exercise is particularly apparent in the case of bone atrophy, i.e. osteoporosis. In the old (western) *Bundesländer* (constituent states) alone, the number of osteoporosis patients is put at four to six million. This illness could be prevented by a diet containing sufficient calcium and by physical exertion.

Dioxin scarcely measurable in mother's milk

According to Düsseldorf Environment Minister, Klaus Matthiesen, young mothers in the state of North Rhine-Westphalia need have no worries when they breast-feed their babies. In the last five years, the amount of the highly-toxic dioxin in mother's milk has reduced by half and is now scarcely measurable. The pollution of the air with dioxins and furanes has dropped by as much as 69% in the major cities on the Rhine and Ruhr in the same period. In Matthiesen's opinion, this positive development is attributable to the prohibition of the chlorine and bromine elements in automobile motor spirit. Another important factor is the behaviour of industry in North Rhine-Westphalia which, as a result of official pressure, has invested DM 5 million since 1991 to reduce dioxin emission by refuse incineration plants, steel works chemical works, chip-board factories and foundries. Of the 26 refuse incineration plants in North Rhine-Westphalia, ten of them maintain a limit value of 0.1 nanogram (1 nanogram = billionth of a gram) of dioxin per cubic metre of waste air. In Matthiesen's estimation this represents "more or less zero emission". Eleven further incinerators will have reached this limit by the end of the year.

Postgraduate courses

Graduiertenkollegs (special postgraduate courses) for the promotion of doctoral candidates have been in existence since 1989. This new training facility for young academics results from a recommendation made by the *Wissenschaftsrat* (Science Council) in 1988. *Graduiertenkollegs* are designed to help reduce the length of time taken to acquire a doctorate and, above all, to provide gifted university graduates with the opportunity to devote themselves free from care to their doctoral studies as scholarship holders. 223 *Kollegs* of this nature already exist in the Federal Republic of Germany, of which 27 are located in East Germany. An evaluation carried out by the German Society for the Promotion of Research showed that doctoral candidates, who are guided in small groups towards the acquisition of their doctorate, achieve their goal considerably more quickly than "loners" following the customary procedure. In the biosciences, postgraduates from *Graduiertenkollegs* obtaining their doctorate were 1.2 years, and in engineering 5 years younger than the average age of those acquiring their doctorate in these two disciplines. As a result of this gain in time, the average age of postgraduates obtaining their doctor's degree was just over 30, and even less in some disciplines. A third of the scholarship holders were women.

Warning against mobile telephones in hospitals

The Federal Health Ministry recommends hospitals, doctors in private practice and nursing homes to forbid, on principle, the use of mobile telephones by patients, visitors or workmen - at least in the critical sectors. Endangered above all are operating theatres, intensive wards, cardiac catheter sectors and analytical laboratories. All medical products whose functions or control are based on electronic components, could be disrupted by mobile telephones. There have been reports, inter alia, of interference in cardiac pacemakers, medicament and infusion pumps, dialysers, respirators and patient-monitoring equipment. The recommendation does not apply to cordless phones in private households which operate via a central installation. Persons with cardiac pacemakers are recommended not to carry a mobile telephone close to their body.

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